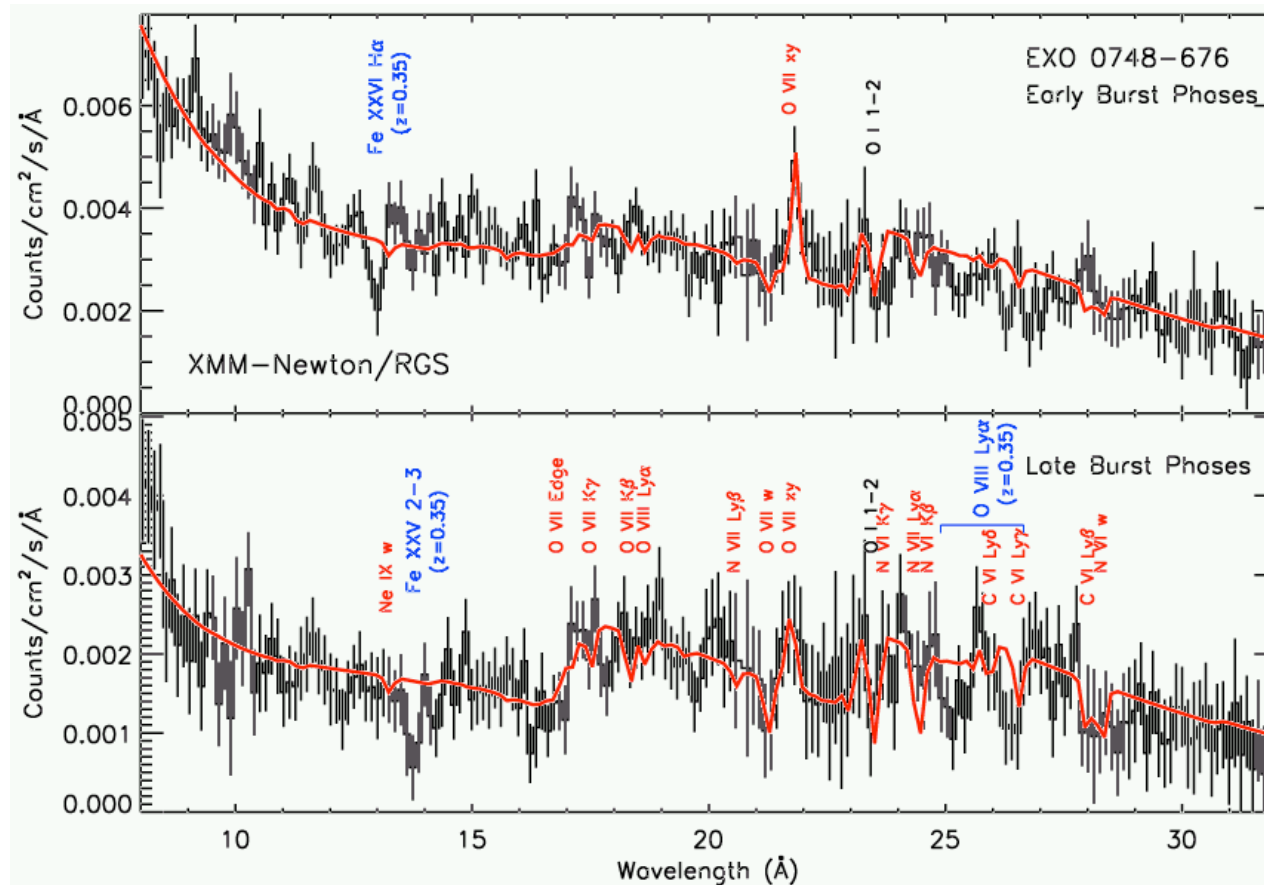

EXO 0748-676: The Continuing Story

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Neutron Star Absorption Features

- * We detected absorption features in the cumulative spectra of 28 x-ray bursts. These were identified as $n=3 \rightarrow 2$ transitions in Fe XXVI and Fe XXV both redshifted by $z=0.35$. This implies $M/R=0.152 M_{\odot}/\text{km}$.



Additional Spectral Content

- * The Fe absorption lines are resolved with large equivalent widths:

$$EW_{\text{FeXXVI}} = 0.13 \text{ \AA} \quad EW_{\text{FeXXV}} = 0.18 \text{ \AA}$$

These are too large to be caused by thermal Doppler broadening without overabundances of $A \geq 100 A_{\odot}$

- * We can estimate the line broadening due to the Stark Effect. For a density of $n_e = 10^{23} \text{ cm}^{-3}$ we find $\Delta E \sim 0.1 \text{ \AA}$!

Detection of multiple transitions in a single ion could provide a measure of the electron density and gravitational acceleration, $g \Rightarrow M/R^2$

- * The higher-order transitions should lie just below the current detection limits:

Lyman: $EW_{\alpha} = 30 \text{ eV}$

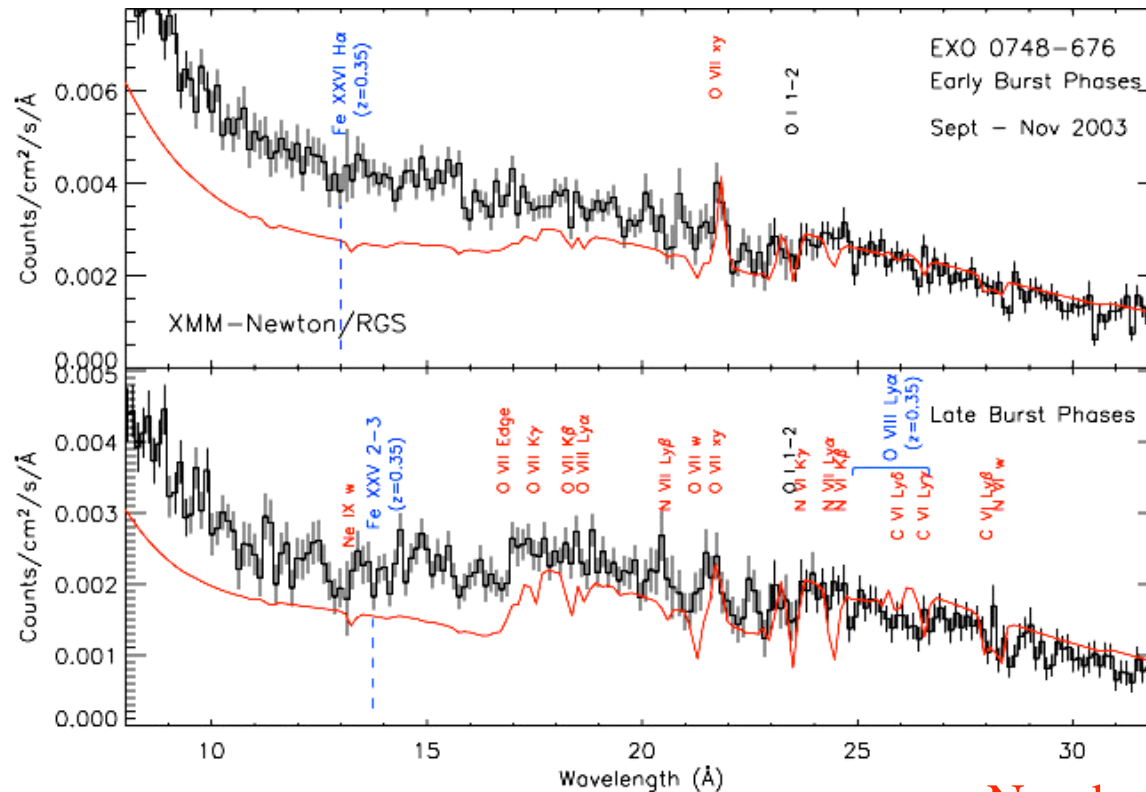
Balmer: $EW_{\beta} = 0.03 \text{ \AA}$ ($EW_{\text{meas}} \leq 0.04 \text{ \AA}$)

Paschen: $EW_{\beta} = 0.2 \text{ \AA}$, $EW_{\gamma} = 0.1$

\Rightarrow Further calculations & observations are required!

New Burst Data

- * Proposed for follow-up observations with XMM-Newton and Chandra:
 - Previous data: 335 ks, 28 bursts, 3200 s exposure
 - XMM-Newton: 584 ks, 68 bursts, 9200 s (4600 s) exposure
 - Chandra: 300 ks, 35 bursts, 3900 s exposure

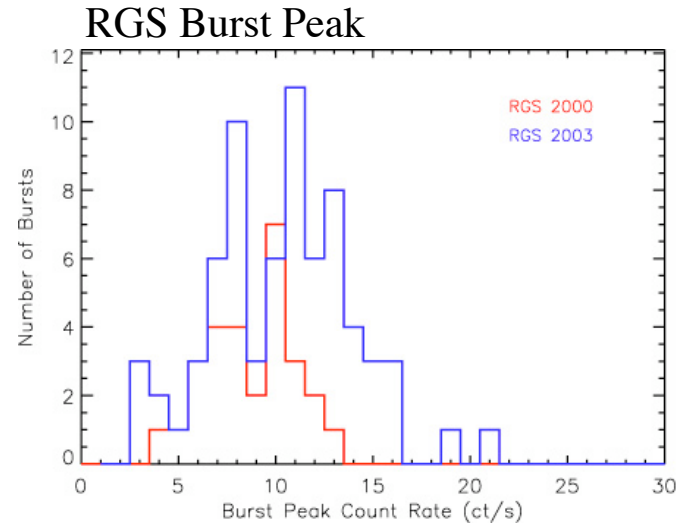
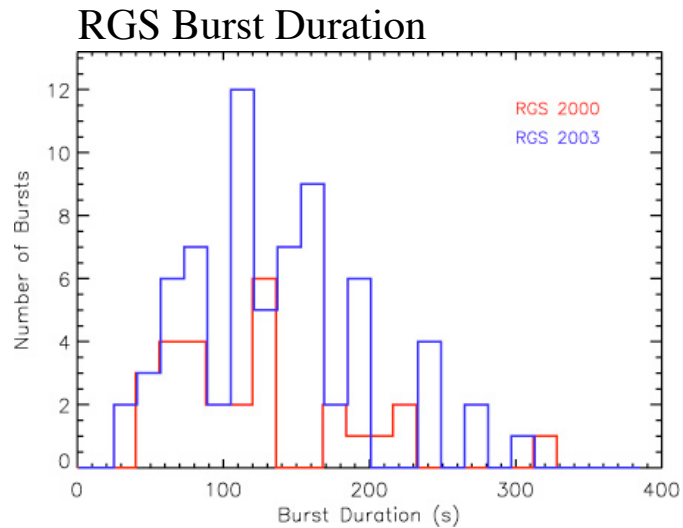


No obvious features!

Why No Observable Features?

- * Did we make a mistake in the first analysis?
 - The observed signal was weak, but spectroscopically consistent
 - The primary critique was that the line widths were too narrow for the expected spin frequencies. Recently, Villarreal & Strohmayer have measured the spin frequency at $\nu_{\text{spin}} = 45 \text{ Hz}$.
- * Is the burst sample different?
 - We had simultaneous EPIC observations for 3 bursts in the first data.
 - Comparing bursts statistics from the RGS data is inconclusive
 - We are currently in the process of characterizing the individual bursts of the new data set using the EPIC/PN observations
- * Is the source stable?
 - We see evidence of changes in the EXO 0748 system.
 - Could this indicate changes in the neutron star photosphere?
 - Fe abundance depends on accretion rate ...
 - Population in $n=2$ depends on LTE ...

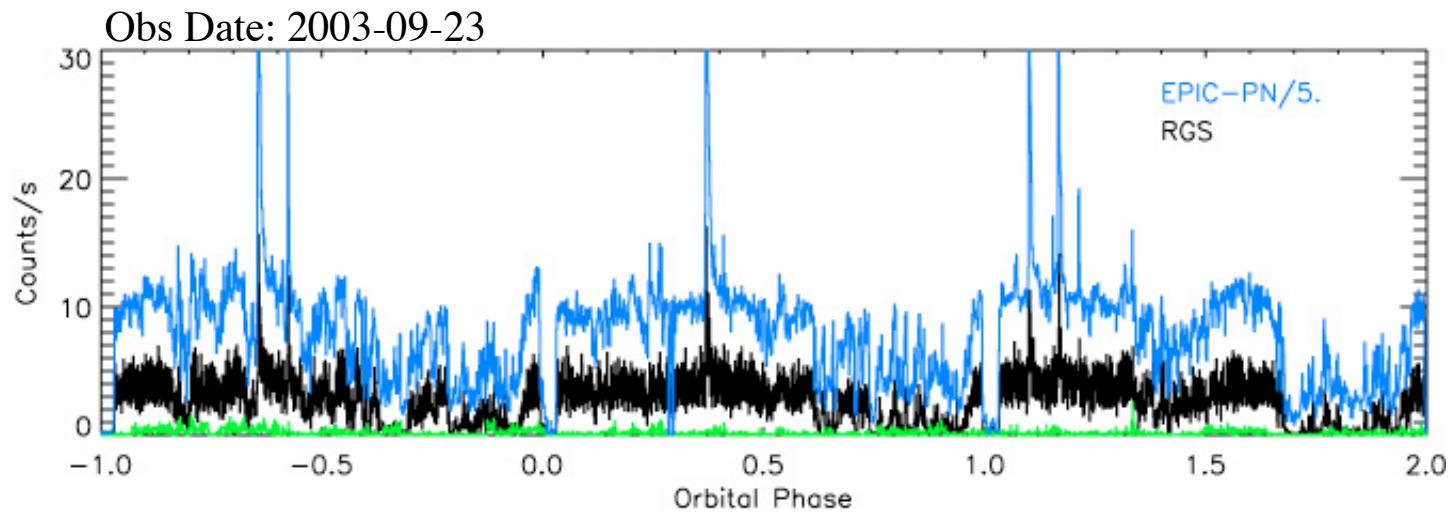
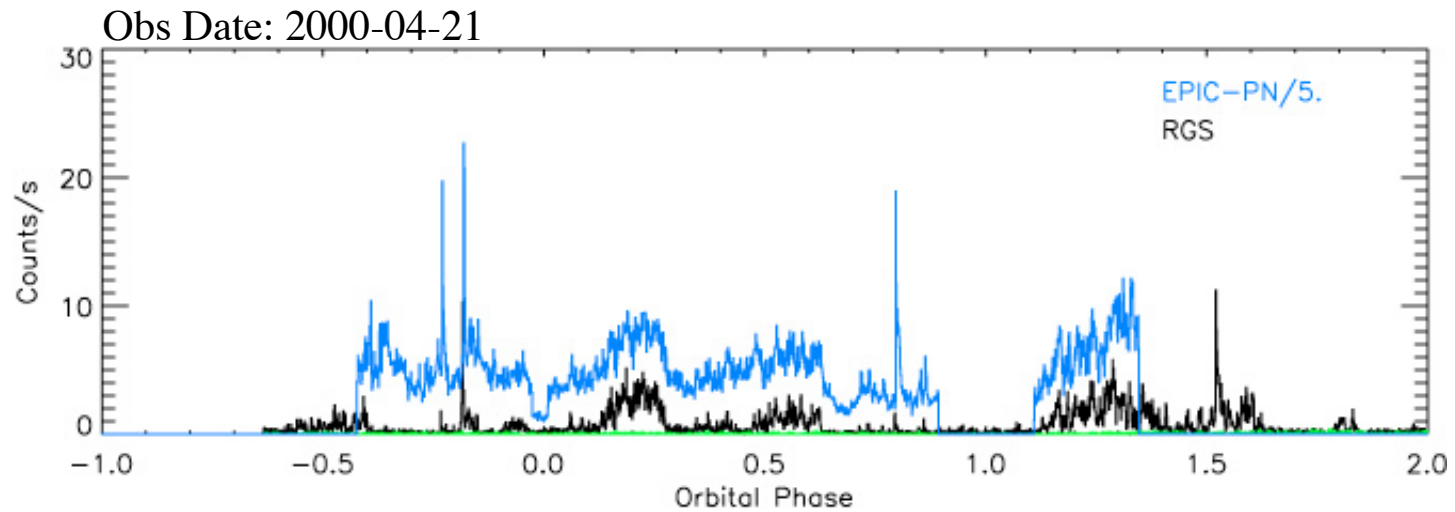
Burst Statistics



EPIC Burst Statistics

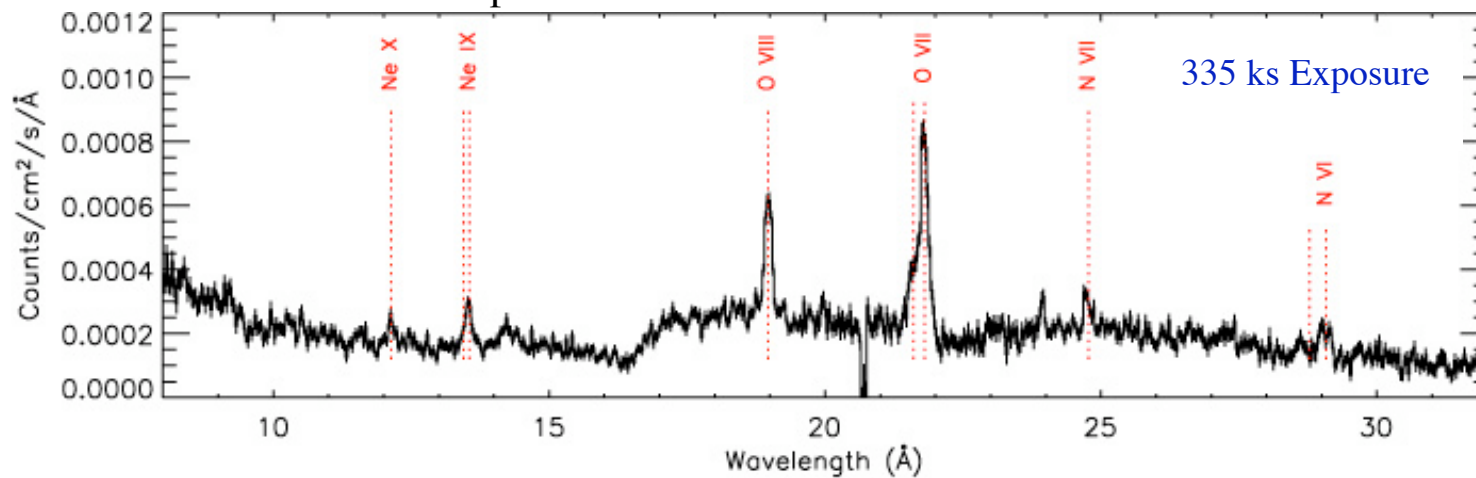
Orbit	Exposure	Singles	Doubles	Triples	kTavg	kTmax
0692	24.6 hr	6	2x2	0		
0693	25.1 hr	6	2x1	3x2		
0694	30.0 hr	7	2x2	3x1		
0695	20.4 hr	3	2x3	0	TBD	TBD
0708	15.2 hr	3	2x1	3x1		
0710	17.3 hr	3	2x3	0		
0719	17.3 hr	5	2x2	3x1		
Total	157.8 hr	33	28	15		

Light Curves

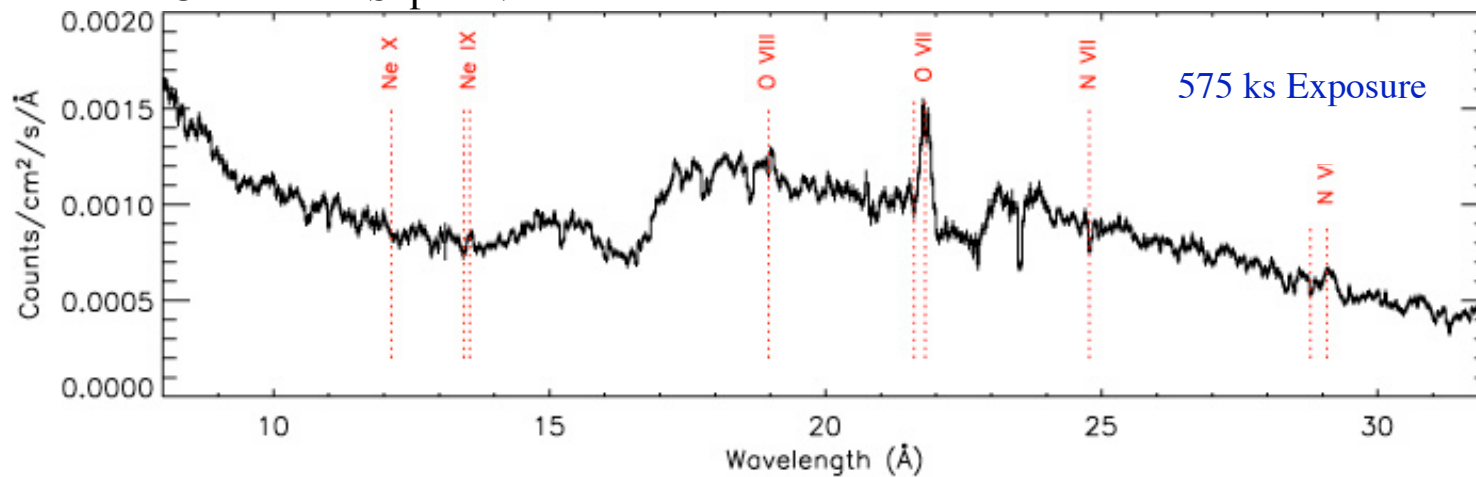


Quiescent Spectra

Obs Dates: Feb - Apr 2000



Obs Dates: Sept - Nov 2004



Summary

- * EXO 0748-676 is a strange and interesting object!
- * The disk structure appears to be changing. The soft x-ray spectrum from the vertically-extended photoionized plasma is now dominated by absorption instead of emission features. The outer edge of the disk now produces the lightcurve of a more traditional dipping source.
- * The average burst spectrum no longer shows red-shifted absorption features. Further analysis is required to determine whether a judicious burst selection will reveal the signal or whether the binary system has changed in ways that may affect the NS photosphere.